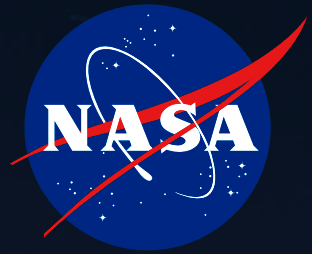


Research Range Services

2013 Annual Report



wallops range

National Aeronautics and Space Administration

Goddard Space Flight Center
Wallops Flight Facility

Dedication

Thomas Bradley Mason



The 2013 Research Range Services Program Annual Report is dedicated to the memory of Thomas Bradley “Brad” Mason, an exceptional young man who served as an intern for the Office of Communications at Wallops Flight Facility.

Brad graduated as the valedictorian of Crisfield High School in 2013. During his high school career, Brad became a drum major of the Pride of Somerset Marching Band and was also a talented trumpet player. A lifelong fan of NASA, Brad dreamed of becoming an aerospace engineer, contemplating a career with the government. Brad had been accepted to the University of Maryland at College Park, where he joined the “Mighty Sound of Maryland” Marching Band.

Aside from music and NASA, Brad was a faithful member of the Asbury United Methodist Church in Crisfield where he was an active member of the church youth group.

Brad’s time at Wallops was short but his impact remains



with us. His eagerness, diligence and his impressive work ethic spanned far beyond his 18 years. We count ourselves among his family and friends who will miss him.

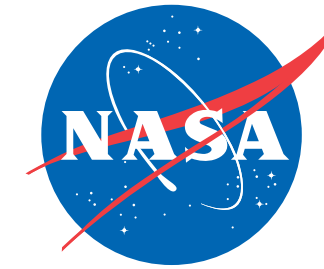


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Range expands its horizons

Fiscal Year 2013 was another banner year for the Research Range Services (RRS) Program as it supported science campaigns in the Pacific, put on the parkas in the Alaskan interior for aurora borealis research, delivered supplies to the International Space Station (ISS) and even launched a mission to the moon – both first-ever accomplishments from the Wallops Range!

In all, RRS engineers and technicians supported 16 launch events at locations around the world and at our home base of Wallops Flight Facility on the Eastern Shore of Virginia. RRS offered consistently superior support to a myriad of customers including all of NASA's mission directorates, the Department of Defense, other U.S. government agencies, foreign exploration agencies, colleges and universities, civilian corporations and the worldwide scientific community by providing tracking, telemetry, meteorological, optical, command and control and Range operations services for the Wallops Range, Poker Flat Research Range near Fairbanks Alaska, and other remote locations such as the Reagan Test Site in the Kwajalein Atoll and Cooper's Island, Bermuda.

The spring and summer were particularly busy as the Wallops

Range ramped up to assist in the launch of the first-ever Antares vehicle while also preparing for a two-rocket salvo to collect data in the Earth's ionosphere, and two other sounding rocket missions, while at the same time deploying mobile systems to Alaska to support future missions. The RRS program's dedicated, experienced and highly skilled engineers and technicians assured error-free, safe Range operations for real-time capture and display of mission-specific flight, payload and science data for a diverse set of flight vehicles, including orbital and suborbital rockets, manned and unmanned aircraft, satellites, aircraft and research balloons.

Systems and capabilities under the auspices of the RRS Program include:

- A Range Operations Management System tool which allows effective management and control of the Range configurations and documentation, maintenance, operations scheduling, asset management, and discrepancy reporting, plus a new digital imaging database for all NASA employees to utilize
- A fully equipped, state-of-the-art Range Control Center with a full complement of command and control equipment as

well as an extensive bank of monitors to provide real-time display of all flight events and Range status

- An aeronautical research airport with three runways and a separate runway dedicated to UAS
- Fixed and mobile radar systems for tracking launch vehicles, satellites and aircraft
- Fixed and mobile telemetry systems to collect state-of-health, position and science experiment data
- Fixed and mobile command and control systems to provide event commanding to vehicles in flight
- Fixed and mobile optical and television systems
- Ground-based and aerial video and photography, professional archiving and printing, and post-production services
- A comprehensive suite of meteorological instrumentation, radars and weather balloons used in collecting atmospheric measurements to provide real-time weather forecasts
- Radar Frequency spectrum allocation, monitoring,

management and coordination

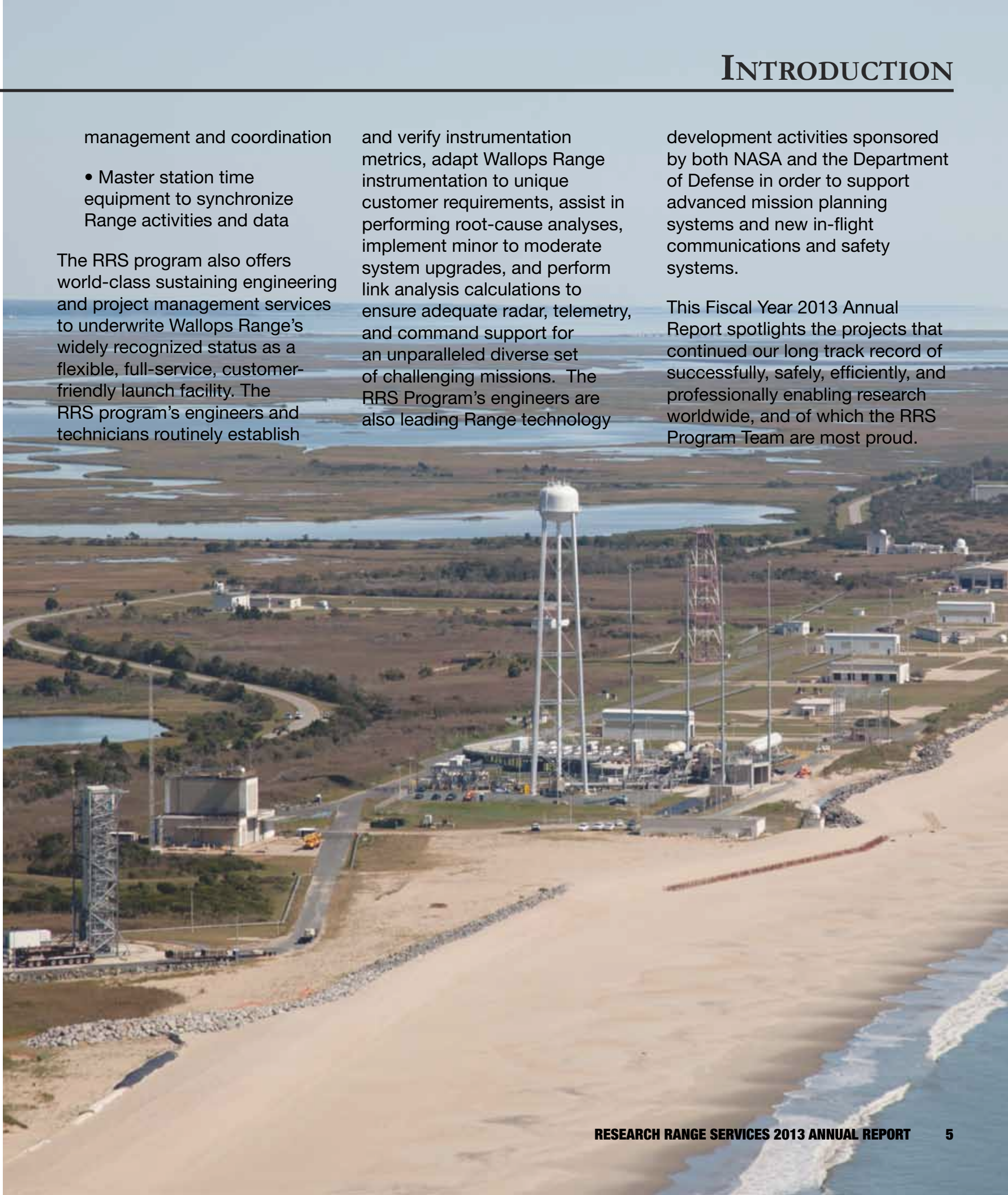
- Master station time equipment to synchronize Range activities and data

The RRS program also offers world-class sustaining engineering and project management services to underwrite Wallops Range's widely recognized status as a flexible, full-service, customer-friendly launch facility. The RRS program's engineers and technicians routinely establish

and verify instrumentation metrics, adapt Wallops Range instrumentation to unique customer requirements, assist in performing root-cause analyses, implement minor to moderate system upgrades, and perform link analysis calculations to ensure adequate radar, telemetry, and command support for an unparalleled diverse set of challenging missions. The RRS Program's engineers are also leading Range technology

development activities sponsored by both NASA and the Department of Defense in order to support advanced mission planning systems and new in-flight communications and safety systems.

This Fiscal Year 2013 Annual Report spotlights the projects that continued our long track record of successfully, safely, efficiently, and professionally enabling research worldwide, and of which the RRS Program Team are most proud.





Superior project management key to Wallops mission successes

The Range and Mission Management Office (RMMO) is a team of highly-skilled project management professionals who are charged with the responsibility of marrying the skills of scientists, engineers, technicians, and other personnel into one cohesive team whose objective is to collect data from a multitude of flight platforms and payloads.

As part of the RMMO, the Research Range Services (RRS) Program supports these project managers and their missions by providing a host of services. These services include, but are not limited to radar and optical tracking, telemetry

Program Management Overview
Directorate: Science Mission Directorate
Division: Heliophysics
Program Executive: Ms. Cheryl Yuhas
Program Manager: Mr. Steven Kremer
Lead Center: Goddard Space Flight Center
Performing Facility: Wallops Flight Facility
Program Type: Research Range Services

downlink, meteorological services, command and control, financial analysis, and engineering services. Together they allow missions to take place in a safe, ready environment.

The RRS program has a deep bench of highly experienced Project Managers (PM) at the ready who build, coordinate, and manage

cohesive teams. PMs tap the minds of engineers and involve the expertise of technicians to configure mobile and fixed Ranges, providing unparalleled launch range services around the globe.

All operations conducted at the Wallops Range and other remote launch ranges, such as Poker Flat Research Range near Fairbanks, Alaska and Andøya Rocket Range in Norway, require state-of-the-art technologies and multi-million dollar systems to support unmanned aerial vehicles, sounding rockets, expendable launch vehicles or any other flight platform. Each operation requires a total commitment to excellence.

Research Range Services personnel, civilian corporations, the Department of Defense and other organizations all work cohesively within the Control Center. The Control Center has historically been referred to as the “heartbeat” of all operations conducted at the Wallops Range.

At Wallops, the rubber meets the road with effective management and smart integration of all aspects of mission support. In 2013, project managers were responsible for Range instrumentation support for NASA orbital and sub-orbital programs, and programs for other government and civilian agencies. They assured 100 percent success for programs executed at the Range while simultaneously managing remote campaigns in Alaska and Kwajalein, plus downrange tracking/ command sites in North Carolina and Bermuda. Highly skilled managers leave no stone unturned, in order to:

- Ensure total success in meeting customer requirements through risk assessment and mitigation, comprehensive operator certification, configuration management,

pre-mission testing, proven operating procedures, and post-mission support.

- Assure a “green Range” for all missions through effective corrective and preventive maintenance for all Range facilities and equipment.
- Creatively use state-of-the-art engineering expertise and technology advancements to meet new mission requirements, improve Range safety, reduce operational costs and replace obsolete equipment.
- Provide expertise and management skills to oversee the technical performance of contract services including setting mission priorities, ensuring sufficient staffing levels, identifying and prioritizing

DID YOU KNOW?

Over the decades, the Wallops Range has launched many satellites into low-earth orbit for military and civil customers. However, it wasn't until 2013 that Wallops launched a payload into deep space. See page 16 for details of a mission to the moon called LADEE.

engineering upgrades and overseeing efforts between NASA engineering and contractor personnel.

From the initial dreams of a principal investigator through the completion of data analysis, the RMMO project manager in coordination with the PM is the glue that bonds the talents and efforts of the extended team of professionals needed to ensure successful completion of every mission.

Research Range Services Assets: \$256.54 million			
Telemetry Systems	Per Unit	Quantity	Total (\$M)
7.3-Meter Fixed Antenna	\$1.5	2	\$3.0
7-Meter Mobile Antenna	\$1.5	2	\$3.0
Mobile Telemetry Van	\$1.5	1	\$1.5
20-Foot Mobile System	\$2.0	1	\$2.0
Mobile Super Van	\$2.5	1	\$2.5
10-Foot Mobile Antenna	\$0.5	1	\$0.5
8-Foot System	\$0.4	2	\$0.8
8-Foot Mobile Antenna	\$0.4	1	\$0.4
8-Meter Antenna	\$2.5	2	\$5.0
16-Foot System	\$0.5	1	\$0.5
9-Meter Redstone	\$6.0	1	\$6.0
9-Meter System	\$4.0	1	\$4.0
Transportable Command and Telemetry System (TCATS)	\$8.5	2	\$17.0
Mobile Integrated Telemetry System	\$0.5	1	\$1.5
11-Meter Antenna	\$2.7	1	\$2.7
Atmospheric Radars	Per Unit	Quantity	Total
Space Range Radar	\$20.0	1	\$20.0
Ultra High Frequency (UHF)	\$18.0	1	\$18.0
S-band Weather (Tropical Ocean Global Atmosphere)	\$5.0	1	\$5.0
NASA Polarimetric (NPOL)	\$5.0	1	\$5.0
Tracking Radars	Per Unit	Quantity	Total
Range Instrumentation Radar – 778C	\$6.0	4	\$24.0
Range Instrumentation Radar – 716	\$7.0	2	\$14.0
Range Instrumentation Radar – 706	\$70.0	1	\$70.0
MPS-39 Radar	\$1.5	1	\$1.5
19-17 Radar	\$1.5	1	\$1.5
Surveillance Radars	Per Unit	Quantity	Total
Airport Surveillance Radar (ASR-8)	\$10.0	1	\$10.0
Sea Surveillance (S- and X-Band)	\$1.0	1	\$1.0
Pathfinder	\$0.7	2	\$1.4
Active Protective System (APS-39)	\$2.5	1	\$2.5
Command & Support Systems	Per Unit	Quantity	Total
Fixed UHF Command System	\$4.0	1	\$4.0
Fixed Poker UHF Command System	\$1.5	1	\$1.5
Mobile Command System	\$1.4	1	\$1.4

Mobile Range Control System	\$2.1	1	\$2.1
Radio Frequency Communication	\$3.0	1	\$3.0
Timing System	\$0.8	1	\$0.8
Optical Systems	Per Unit	Quantity	Total (\$M)
Video Tracking Stations	\$1.0	5	\$5.0
Photographic Stations	\$0.3	5	\$1.5
Radar-slaved Mobile Optical Tracker	\$0.4	1	\$0.4
Video Distribution and Recording	\$2.1	1	\$2.1
Meteorological Systems	Per Unit	Quantity	Total (\$M)
Electric Field Mills	\$0.02	7	\$0.14
Leading and Environmental Display System	\$0.30	1	\$0.30
Range Control	Per Unit	Quantity	Total
Range Control Center	\$10.0	1	\$10.0

Wallops makes history with new Antares vehicle launches

WALLOPS RANGE, Va. – After one of the largest buildups in the history of the Wallops Range, Research Range Services (RRS) personnel realized a dream in 2013 by supporting the launch of two medium-class space launch vehicles known as Antares. Named after a red supergiant star in the Milky Way Galaxy and built by Orbital Sciences Corporation, this brand-new launch vehicle was developed as part of the Commercial Orbital Transportation Services (COTS) contract for resupplying the International Space Station (ISS).

Antares A-ONE

The successful launch of the first-ever Antares launch vehicle April 21, 2013, marked the culmination of an enormous multi-year effort, which perfectly placed a payload simulator into short orbit and demonstrated the program’s ability to move into Cygnus operations and resupply of the ISS.

RRS dedicated the full-time support of two project managers, ground operations manager, ground operations crew, mission engineer, civil engineer and test engineer; Significant time from



The first Antares vehicle launched April 21, 2013, from the Wallops Range.

various Range operators and engineers was needed to meet the continual needs of the program.

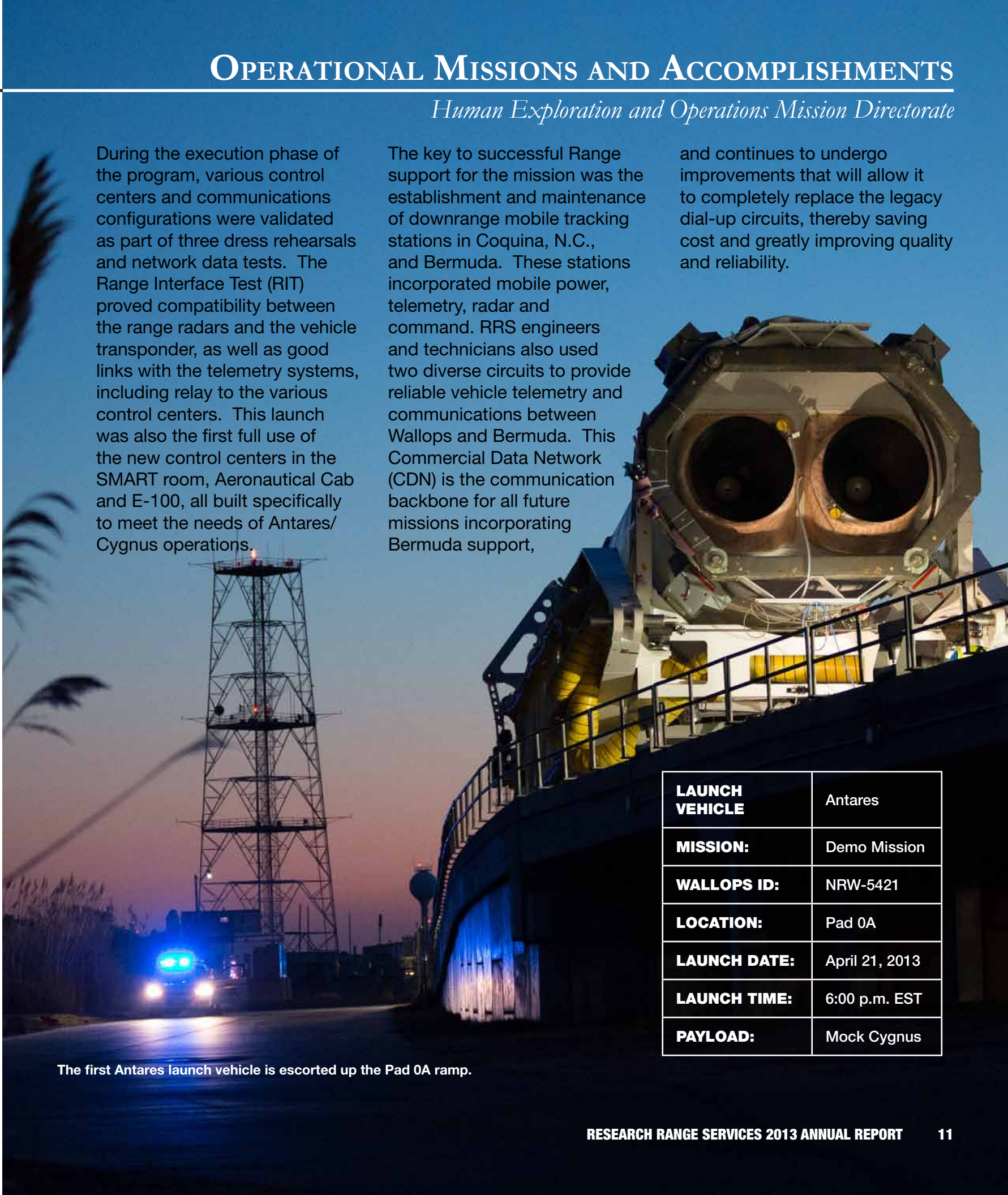
Services provided for the Antares A-ONE mission included precision tracking radar, telemetry operations, range timing and communications, radio frequency (RF) monitoring, surveillance radar operations, Range air and sea surveillance, NASA Communications (NASCOM), weather forecasting, meteorological operations, optical

systems, Range scheduling services, and post-production deliverables for pre-launch and launch operations. All requirements were met and all deliverables were complete and on-schedule. One unique aspect of this mission was the teaming effort between RRS’s Optical Systems Group and a team from Kennedy Space Center. Together, these two teams produced the largest amount of photographic and video data ever collected for one mission at Wallops.

During the execution phase of the program, various control centers and communications configurations were validated as part of three dress rehearsals and network data tests. The Range Interface Test (RIT) proved compatibility between the range radars and the vehicle transponder, as well as good links with the telemetry systems, including relay to the various control centers. This launch was also the first full use of the new control centers in the SMART room, Aeronautical Cab and E-100, all built specifically to meet the needs of Antares/ Cygnus operations.

The key to successful Range support for the mission was the establishment and maintenance of downrange mobile tracking stations in Coquina, N.C., and Bermuda. These stations incorporated mobile power, telemetry, radar and command. RRS engineers and technicians also used two diverse circuits to provide reliable vehicle telemetry and communications between Wallops and Bermuda. This Commercial Data Network (CDN) is the communication backbone for all future missions incorporating Bermuda support,

and continues to undergo improvements that will allow it to completely replace the legacy dial-up circuits, thereby saving cost and greatly improving quality and reliability.



The first Antares launch vehicle is escorted up the Pad 0A ramp.

LAUNCH VEHICLE	Antares
MISSION:	Demo Mission
WALLOPS ID:	NRW-5421
LOCATION:	Pad 0A
LAUNCH DATE:	April 21, 2013
LAUNCH TIME:	6:00 p.m. EST
PAYLOAD:	Mock Cygnus

Antares ORB-D1

The second Antares launch, known as ORB-D1, set sail from the shores of the Atlantic Ocean Sept. 18, 2013, taking just a few minutes to penetrate the edge of space. This was the first Antares vehicle to actually carry the new Cygnus spacecraft, ferrying approximately 1,300 pounds of cargo to the ISS.

RRS personnel had only 11 days to compress approximately 30 days of work in preparation for ORB-D1 following the successful launch of the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission. This quick turn around required focused project management to arrange the Mission Dress Rehearsal, combined

systems testing, Range end-to-end testing, and downrange systems verifications checks on the fixed instrumentation systems at the Wallops Range and mobile sites at Bermuda and Coquina, N.C.

Either of these two enormous programs would be challenging to any Range; however, considering the complex deployment of mobile systems and the interwoven schedules of two separate medium-class

space vehicles, RRS personnel performed remarkably both at home and abroad. The teams made seamless configuration changes for telemetry, radar, command and control, optical services, and many other services to support the pre-launch requirements.

This dramatic Range turnaround also shows the strong partnerships RRS has with Orbital and the Mid-Atlantic Regional Spaceport (MARS), owner of the Pad 0A facility. These three entities worked tirelessly to prepare the vehicle, launch facilities and the Range for operations.

A bright future is forecasted for Antares as two to three launches are scheduled for 2014.

Editor's Note: At the time of publication, the next Antares mission, ORB-1, is scheduled for mid-December 2013.

LAUNCH VEHICLE	Antares
MISSION:	ORB-D1
WALLOPS ID:	NRW-5422
LOCATION:	Pad 0A
LAUNCH DATE:	Sept. 18, 2013
LAUNCH TIME:	10:53 a.m. EST
PAYLOAD:	Cygnus

Pad tests lead way to the ISS

WALLOPS RANGE, Va. — The first launch of Antares would never have happened without the successful completion of two important milestones this past year. Known as 5K and 7K testing, these two tests proved-out various functions of the fuel farm, the first stage of the vehicle and the readiness of Pad 0A.

During a few weeks beginning in December 2012, 5K testing commenced as three separate “cold flow” tests were conducted. With the support of the RRS ground operations crew and many other support organizations, 5K testing proved that fuel commodities could be safely and successfully transferred from the fuel farm into the first stage of the Antares vehicle through a system which serves as the plumbing to the vehicle. The tests consisted of three procedures which validated operation of the pad commodities system, the launch vehicle functionality and the Orbital Commodity Control System.

Once 5K testing was complete, RRS readied for a short test fire of the first stage – known as 7K testing.



For roughly 20 seconds on Feb. 22, 2013, the first stage was anchored to Pad 0A and ignited, which provided quite a show in the early evening hours. This test proved the performance of the two engines aboard the vehicle and the durability of Pad 0A.

Throughout, the RRS ground operations team continued to exceed expectations and meet the demanding needs of the Antares program. The scope of operations included: Alternate facilities manager duty, nitrogen recharger activities, sounding rocket support, pressure system operations, and second shift staffing at the Horizontal Integration Facility (HIF). The team supported HIF nitrogen system pumps, as well as three pad nitrogen pumps per week. There are roughly seven separate pressurization systems across three different Range facilities, and RRS has played a huge role maintaining all of them and keeping them productive.

DID YOU KNOW?

Antares is about the size of a 13-story building, standing 131.5 feet tall. The two AJ26 engines used in the rocket's first stage are based on the NK-33 engine, which was originally developed to launch Russia's giant N-1 moon rocket in the 1960s.



From Wallops to the Moon

WALLOPS RANGE, Va. – “We choose to go to the moon in this decade and do the other things. Not because they are easy, but because they are hard,” said John F. Kennedy in 1962. This iconic statement rings true today as the Research Range Services (RRS) supported a first-ever mission at the Wallops Range – an unmanned mission to Earth’s only natural satellite.

Aboard a Minotaur V expendable launch vehicle, the Lunar Atmosphere Dust Environment Experiment – better known as LADEE – lifted off from Pad 0B at the Wallops Range Sept. 6, 2013. After a near-flawless count and with perfect weather conditions, LADEE soared into a clear, beautiful sky on the first minute of the launch window. This was the first-ever interplanetary mission on the first-ever Minotaur V launched from Wallops Flight Facility. LADEE was sent to the moon to gather information about the fragile lunar atmosphere before further exploration disturbs it.

This ground-breaking feat was the culmination of years of effort from multiple agencies across the country. Here at Wallops, RRS

provided Range support not only locally, but also from downrange tracking sites at Coquina, N.C., and Bermuda. These off-axis sites provided coverage as the vehicle moved downrange, ensuring that critical data during the fly-out was received and recorded at Wallops. RRS also supported several pre-launch tests, performed system checks, and worked closely with Range users to thoroughly verify readiness to launch.

Beyond the launch itself, the LADEE project spurred major upgrades to Wallops Range facilities. The two most notable were the transformation of Building U-40 to a Launch Control Center (LCC) and the conversion of Building V-55 from a fueling facility to an ISO-certified clean room. This was a base-wide effort involving several groups which required close coordination by RRS project management.

With the usual LCC not available for use at Building W-20, the LADEE team had to determine a new location. Given that U-40 had been used as a LCC several years ago and still had some of the infrastructure, it seemed a logical choice. The LADEE requirements manager worked closely with the

project lead and several entities at Wallops to ensure each of the building’s requirements were met.

An even bigger challenge was faced in converting the V-55 Spacecraft Fueling Facility (SFF) into a clean room capable of processing the LADEE spacecraft. This building presented several challenges given that it was set back in the woods – making “critter control” difficult at best. The RRS project manager worked closely with NASA’s Code 500 engineering personnel who took the lead on updating this facility. In the end, the LADEE spacecraft was provided a safe and clean temporary home while it underwent final processing for its journey to the moon.

Many other Range services were required, such as meteorological operations, command and control and other services. This mission also included collaboration between the Optical Systems Group from RRS and Kennedy Space Center in Florida. RRS personnel took the lead to coordinate supplemental support which allowed the customer bonus video data for future evaluation.

In the end, the LADEE mission was a great success for the entire Wallops Range team and especially for RRS. This launch could help pave the way for future interplanetary missions from Wallops Range and help usher in a new era of exploration to the moon and beyond.

LAUNCH VEHICLE	Minotaur V
MISSION:	LADEE
WALLOPS ID:	NRW-4791
LOCATION:	Pad 0B
LAUNCH DATE:	Sept. 6, 2013
LAUNCH TIME:	11:27 p.m. EST
PAYLOAD:	LADEE



DID YOU KNOW? LADEE was the No. 1 trending topic on Twitter on the day of launch. It aired live in New York's Times Square, and more than 7 million people were actively following the launch via official NASA websites and social media accounts. And then, of course, there was the frog, taken by a remote camera set up by RRS personnel from the Optical Systems Group.

Lithium test lights the Winter sky

WALLOPS RANGE, Va. – Range Research Services (RRS) personnel supported the launch of a two-stage Terrier Mk70 - Improved Orion sounding rocket Jan. 29, 2013, from the MRL Launcher at Pad 2. The mission was a test flight of the lithium canister design for a future missions – the Daytime Dynamo and Equatorial Vortex Experiment (EVEX).

The experimental payload included two canisters, each using a different lithium loading technique. The launch needed to occur in twilight conditions since lithium requires solar illumination to be visible. At the same time, conditions on the ground needed to be sufficiently dark so that the lithium releases could be seen against the sky background.

A unique asset was included as part of the operation. The RRS airfield manager coordinated with the NASA Aircraft Office to incorporate the use of NASA-8 – a King Air B-200 propeller-driven aircraft. The mission's principal investigator placed optical instrumentation aboard the aircraft to obtain airborne scientific data of the lithium trails at 30,000 feet. A communications plan was also put into effect to allow the science team on the aircraft to communicate with the Range Control Center (RCC) and the

science photographers on the ground.

Other hurdles presented challenges to RRS. During this mission, RRS personnel needed to clear two obstacles to ensure proper weather support. First, the entire Weather Office was being renovated and had to conduct its support from a temporary secondary location. Second, the Leading Environmental Analysis and Display System (LEADS) – a system which gathers satellite weather imagery as well as other data – was being upgraded. RRS engineers and technicians were able to relocate weather personnel while performing factory acceptance testing on LEADS. This extraordinary support was completed in a fashion which allowed the mission to carry on with no realized loss in service.

Other RRS support functions included critical telemetry, precision tracking radar, timing, radio frequency monitoring, communications, surveillance radar, Range data processing and display operations, Range surveillance, weather forecasting, meteorological operations, optical tracking, and launch system integration. RRS also provided mission planning, project management and scheduling services.



A Terrier Mk70 - Improved Orion takes off from the Pad 2 MRL launcher.



Lithium is released from a canister loaded in the rocket's payload.

LAUNCH VEHICLE	Terrier Mk70 - Improved Orion
MISSION:	Lithium Thermite Test Flight
WALLOPS ID:	NRW-5416
LOCATION:	Pad 2 - MRL
LAUNCH DATE:	January 29, 2013
LAUNCH TIME:	6:50 p.m. EST

VISIONS at Poker Flat

Atmospheric research studies Aurora Borealis

POKER FLAT RESEARCH RANGE, Alaska — For a fifth consecutive year, the Research Range Services (RRS) program transferred a mobile range and personnel more than 4,000 miles across the North American continent to support yet another atmospheric science mission. Deep into the Alaskan interior, a mission called Visualizing Ion Outflow via Neutral Atom Imaging (VISIONS) was about to take flight in early February 2013 at Poker Flat Research Range (PFRR) just outside Fairbanks, Alaska.

On a bitterly cold day, the first-ever Talos-Terrier-Oriole-Nihka rocket roared into the sky Feb. 6, 2013, carrying the VISIONS payload on its scientific mission to study the aurora borealis.

On launch day, the RRS team arrived at PFRR to find overcast skies and steadily falling snow. To compound the problem, throughout the evening, visibility hovered right on the edge of acceptable limits, leading everyone to believe chances of launching were very slim. As the evening progressed, however, improved science conditions began to materialize and visibility stayed on the edge of its limits. Then finally, just before midnight, the science conditions stabilized long enough for successful launch into the atmosphere.

This mission presented several challenges for the team, but in each case, they were able to overcome in order to provide the required launch support. Arriving in early January 2013, the RRS team began evaluating systems to ensure launch readiness. The extreme temperatures seen in PFRR during the winter months can wreak havoc on the mechanical systems and this year was no exception. In the days leading up to the mission, technicians performed



An RRS meteorological technician prepares a weather balloon to gather wind data.



RRS personnel monitor telemetry readout data during operations.



The RRS project team from Wallops poses for a group photo.

troubleshooting actions, sometimes braving the frigid temperatures to repair components which are located outside the comfort of indoor systems in order to bring the equipment back to operational status for launch support. In the end, all systems were ready when the science conditions came together.

Luckily, it wasn't all troubleshooting for the team, as this year saw many successful "firsts" for equipment at PFRR. For the first time, in 2013, technicians used a separate Data Quality (DQ) room. In prior missions,

the DQ operator managed the many required displays using only two computer screens and space consisting of one table end. The new DQ room now encompasses space allowing for up to two operators. In a technological leap, DQ operators utilize a fully redundant six-screen system that not only plots the present position and predicted impact point of the vehicle, but also displays an array of vehicle position metrics during fly-out. Beyond this, RRS saw smaller upgrades to several other systems, including an upgraded Antenna Control Unit in the 8-meter antenna, as well as the first use of the Vehicle Telemetry and Range Safety (VTARS) system, which replaced the old TelPro telemetry processing units.

These upgrades provide increased capabilities and reliability over older systems.

In the end, the hard work and dedication of the RRS team culminated in successfully tracking the blazing rocket through the cloud cover, ensuring the scientists were able to collect the required data that would allow them to learn more about our atmosphere.

The Talos-Terrier-Oriole-Nihka sounding rocket launches from PFRR.



LAUNCH VEHICLE	Talos-Terrier-Oriole-Nihka
MISSION:	VISIONS
WALLOPS ID:	NRO-5037
LOCATION:	Poker Flat Research Range in Alaska
LAUNCH DATE:	Feb. 6, 2013
LAUNCH TIME:	4:23 a.m. EST

Ventions mission aims for liquid-fueled rockets

Wallops Range, Va. – The Defense Advanced Research Projects Agency (DARPA) Ventions Liquid-Fueled Rocket Flight 1 (VR-1) mission was intended as a stepping-stone to larger launch vehicles capable of small lift access to Low Earth Orbit (LEO). The VR-1 launch vehicle is a small, unguided, and pressure-fed liquid-fueled sounding rocket.

The VR-1 launch vehicle (LV) is a key risk reduction milestone towards a two-stage pump fed liquid oxygen and rocket propellant type 1 nano satellite LV currently being developed by Ventions, LLC., with funding from DARPA and NASA.

This mission was set to fly Nov. 11, 2012, but didn't make it off the rail due to unsafe launching conditions; however, the objectives of the mission were met.

The VR-1 mission parameters, such as elevation and azimuth angle, maximum altitude, and burn times are not particularly important or rigid. The real value of the VR-1 mission was as a pathfinder exercise, going through the process of attempting a launch at WFF and familiarizing the various range elements (range safety, range management, range services, etc.) with Ventions and the LV technology being developed.



The Ventions liquid-fueled rocket seen from a surveillance helicopter.

LAUNCH VEHICLE	VR-1
MISSION:	VR-1 Mission
Wallops ID:	DRW-5110
LOCATION:	Pad 2 - MRL
LAUNCH ATTEMPT DATE:	Nov. 11, 2012

RRS mobilizes to enable worldwide research

KWAJALEIN ATOLL, Marshall Islands – A long-standing motto of the Research Range Services (RRS) program has been “Enabling Worldwide Research” with special emphasis on worldwide. The RRS program boasts a mobile range that consists of radar, telemetry, command and control and communications systems. At the drop of a hat, these systems can be gathered and shipped to any launch location in the world.

This past year, the RRS mobile range was dispatched to the South Pacific to collect data on the Earth's ionosphere and radio frequency propagation, as well as space weather and its impact on communication and navigation systems.

A series of four sounding rockets were launched between May 1 and May 9, 2013, during the successful Kwajalein launch campaign. These suborbital vehicles flew from Roi-Namur Atoll, Republic of the Marshall Islands. Two rockets supported the Equatorial Vortex Experiment, or EVEX – a NASA mission – and two supported

the Metal Oxide Space Cloud experiment, or MOSC, which was a Department of Defense (DoD) mission.

RRS personnel provided logistics support during pre-mission activities, a mobile telemetry readout capability, meteorological operations, photography and a video surveillance system, software engineering, and project management support for each mission. RRS personnel worked in

conjunction with the existing systems on both Roi Namur and Kwajalein Atolls, thus saving wear and tear and a significant amount of funds on other instrumentation normally required for a remote campaign.

The EVEX mission studied space weather in the ionosphere, specifically the circulation of ionized gas, the intensity of which is believed to be related to post-sunset ionospheric storms that can impact satellite communication and navigation systems and signals. As part of the mission and during rocket flights, red and white vapor clouds formed to allow the scientists to observe the winds in the upper atmosphere.

The MOSC payloads released a Samarium vapor creating a red cloud of charged particles in the ionosphere. Researchers from the Air Force Research Laboratory studied the cloud as it dispersed and its impact on radio transmissions sent from multiple locations. MOSC was launched with the assistance of the DoD Space Test Program.

Dynamo rockets blast off on Fourth of July

WALLOPS RANGE, Va. – A joint science project between NASA and the Japan Aerospace Exploration Agency (JAXA) was conducted to study a global electrical current called the “Dynamo” which sweeps through the ionosphere. Research Range Services (RRS) personnel assisted in the launch of two sounding rockets a mere 15 seconds apart. Wallops celebrated the nation’s 237th birthday with its own aerial show as the two vehicles took flight in the morning hours on Independence Day 2013.

The original launch window of June 24 through July 8, 2013, proved a challenging time for the Wallops Range as the summer months provide local fishermen many opportunities to grab the big catch in the Atlantic Ocean. When coupled with poor weather conditions, RRS personnel worked through six scrubbed launch attempts before successfully completing the mission.

The weather constraints included high sea states, cirrus clouds, high surface and ballistic winds and thunderstorms, always a challenge during the summer. In the end, the RRS Meteorological Operations team launched a total of 17 GPS radiosonde balloons and 26 chaff balloons for the campaign.

The first vehicle, a Black Brant V, carried

The Terrier MK70 - Improved Orion sounding rocket takes off from the Pad 2 MRL launcher.

LAUNCH VEHICLE	Black Brant V; Terrier Mk70 - Improved Orion
MISSION:	Daytime Dynamo
WALLOPS ID:	NRW-4978, NRW-4977
LOCATION:	Pad 2 - ARC, MRL
LAUNCH DATE:	July 4, 2013
LAUNCH TIME:	10:30 a.m. EST

a payload that collected data on the neutral and charged particles in the ionosphere. The second rocket, a Terrier Mk70 - Improved Orion, released a long trail of lithium gas to track how the upper atmospheric wind varies with altitude. These winds are believed to be the drivers of the Dynamo currents.

RRS personnel also provided telemetry, precision tracking radar, timing, radio frequency monitoring, communications, surveillance radar, range data processing and display operations, range surveillance, weather forecasting, meteorological operations, optical tracking, and launch system integration. Additional RRS support included mission planning, project management and scheduling services.



In a photo taken by Brad Mason, the Black Brant V takes off as students safely watch from the designated viewing area.

The end result of any successful operation is a happy and content principal investigator.

“From the standpoint of operations, these rocket launches really showcased Wallops at its best,” Dr. Robert F. Pfaff said. “The Range had to deal with winds and fishing boats, including a sailboat without a radio that was in our launch area. The Range was extremely proactive, and adjusted the azimuths of the rockets to enable safe launch conditions. I am greatly impressed and appreciative of the ability of the Wallops Flight Facility to launch these rockets this morning and to enable us to gather this unprecedented data set.”

“From the standpoint of operations, these rocket launches really showcased Wallops at its best.”

— Dr. Robert F. Pfaff

A Black Brant V takes off from Pad 2’s ARC launcher.

Global Hawk spreads its wings for hurricane research

WALLOPS ISLAND, Va. — For the second consecutive year, the Research Range Services (RRS) airfield hosted two Global Hawk (GH) vehicles to conduct hurricane research in the Atlantic Ocean. The mission, known as Hurricane and Severe Storm Sentinel (HS3), is a five-year NASA Airborne Science mission, specifically targeted to enhance our understanding of the processes that underlie hurricane intensity change in the Atlantic Ocean basin. The mission involves three years of Global Hawk science flights from the Wallops Range and will continue during Fall 2014.

Flight operations occurred between Aug. 14 and Sept. 26, 2013, and between the two GH aircraft, 15 science flights took off from the airfield. RRS personnel were presented with major challenges to effectively support this mission, as all HS3 operations moved to the D-1 hangar from the N-159 hangar. Operations would now be conducted out of the new Global Hawk Operations Center-E (GHOC-E) for the first time.

Support from RRS included:

- The Weather Office provided weather forecast briefings every day during the science period to cover the weather at both the Wallops location and all of the divert airports.
- Tower air controllers coordinated with the Wallops Flight Facility wildlife biologists to reduce the risk of bird strikes.
- Airfield personnel coordinated to have the arresting gear de-rigged on Runway 04-22 before each scheduled GH departure and approach.

Technicians check the instrumentation on a Global Hawk aircraft after it landed at Wallops following its flight from Dryden Flight Research Center.



The Global Hawk pilots will operate from the newly configured and upgraded D-1 building.

D-1 upgrades a huge step for aircraft operations

WALLOPS RANGE, Va. — In order to support the 2013 Global Hawk mission, a new operations area had to be configured in Building D-1, a Wallops hangar which was the new home for the project.

The RRS team led the acquisition of a 4.9-meter Ku-band fixed antenna and managed its installation at the Wallops Range in early April 2013. Then, RRS engineers and technicians supported a NASA Dryden-led team in the integration and test of all key electronics in GHOC-E. A major milestone was realized June 28, 2013, when the RRS team conducted a comprehensive system test with a Global Hawk on the ground at Dryden while being controlled by GHOC-E.

RRS personnel provided project management during the fabrication and installation of seven radio frequency (RF) antenna masts on the north side of D-1 in early June 2013, and the

RRS team then installed the antennas and cables on those masts. Effective RRS project management also married the efforts from other Wallops service agencies to ensure IT connectivity, voice and data, and video distribution.

The major challenge in constructing GHOC-E was successfully completing the effort within the short four-month construction schedule in order to have it ready for Dryden's integration activities and testing, and ultimately the arrival of the first Global Hawk Aug. 14, 2013.

Collaboration between the two NASA centers impressed the HS3 project manager from NASA's Ames Research Center, who was pleasantly surprised that the RRS team and Dryden were able to construct, integrate, test, and have GHOC-E fully operational within such an aggressive schedule.

CIBER reaches for the stars

Wallops Range, Va. – The Cosmic Infrared Background Experiment (CIBER) successfully flew aboard a Black Brant XII sounding rocket June 5, 2013, from from the Pad 1 50K launcher. The purpose of this mission was to investigate the spectral and spatial properties of the extragalactic near-infrared background, and required acquisition of multiple targets – which Research Range Services (RRS) instrumentation captured successfully.

This was the fourth flight RRS has supported under the CIBER banner, but the first at the Wallops Range. Previous flights for CIBER were conducted at White Sands Missile Range, N.M., in 2009, 2010 and 2012. The principal investigator decided to fly over the Atlantic on this fourth and final mission to use a more powerful sounding rocket

for higher elevation attainment.

“The objectives of the experiment are of fundamental importance for astrophysics, to probe the process of first galaxy formation, but the measurement is also extremely difficult technically,” said Dr. Jamie Bock, CIBER principal investigator from the California Institute of Technology.

RRS personnel provided project management which coordinated the support of Range instrumentation including telemetry, timing, radio frequency monitoring, precision radar tracking, surveillance radar, Range data processing and display, air and sea surveillance, communications, meteorological operations, and optical systems.

LAUNCH VEHICLE	Terrier Improved Orion
MISSION:	CIBER
WALLOPS ID:	NRW-5411
LOCATION:	Pad 1 - 50K
LAUNCH DATE:	June 5, 2013
LAUNCH TIME:	11:00 p.m. EST
PAYLOAD:	Cosmic Infrared Background ExpeRiment

A long-exposure photograph shows the path taken by the Terrier Improved - Orion carrying the CIBER payload.

Wallops Airfield opens the skies

Restricted airspace allows myriad of flight operations

Wallops Range, Va. – The Research Range Services (RRS) Airfield supported hundreds of aircraft during fiscal year 2013, which included the largest aircraft in service today, the Antonov. Other aircraft included the Proteus and the unmanned X-47B, and many other military aircraft.

The airfield is a full-service airport boasting three runways, two taxiways, three ramps and one hazardous cargo loading area. The runways at the airfield include:

- 10/28 – 8,005 feet
- 04/22 – 8,750 feet
- 17/35 – 4,810 feet

RRS air traffic controllers provide real-time coordination as well as a safe and expeditious flow of air traffic throughout Wallops’ restricted airspace. They assist scheduled aircraft arrival and departure as well as unexpected incoming aircraft who experience emergencies. These air traffic controllers also assist the Wallops Range in conducting operations with air control for surveillance aircraft.



The Proteus science aircraft arrives at the RRS Airfield.

During the past year, several operations kept airfield personnel busy. The arrival of the world’s largest serviceable aircraft, the Antonov, arrived carrying the second Cygnus spacecraft. Ground personnel and many other support services coordinated with the air control tower for arrival, unloading and departure. In addition to operations, the most involved project of the year was the preparation of the Field Carrier Landing Practice (FCLP) mission (see page 34.)

Other aircraft supported are:

- Proteus, MABEL Science Program
- NASA’s Global Hawk and ER-2
- U.S. Navy X-47B
- Joint Strike Fighter F-35
- PAX Search and Rescue (SAR)
- 104th Fighter Squadron Combat Search and Rescue

Training

- C-17 arrival and offload of ORS-3 payload
- HondaJet Water Ingestion Testing
- Virginia Fish and Wildlife as well as U.S. Fish and Wildlife
- Navy F18, P-3, T-2, P8 and H-60 training
- U.S. Air Force F-16, A-10 and 727 training flights
- U.S. Coast Guard - C130 and helicopter
- Maryland State Police 4 Medical Evacuation flights for patients in the surrounding area
- Wallops Code 830 Project flights
- Maintain and operate the Navy E-28 Arresting gear on runway 04/22



The Wallops Fire Department help create a pool of water that will help analyze the effects of water being ingested into an aircraft's engines.

HondaJet tests aircraft water ingestion

WALLOPS ISLAND, Va. — Research Range Services (RRS) conducts hundreds of operations per year; however, few missions present the unique challenge of taxiing a multimillion dollar aircraft near takeoff speeds through a pool of water to analyze the effects of water as it's being ingested into the aircraft's engines. Being one of only a few airfields in the world which will conduct such an operation, HondaJet entrusted the RRS airfield and its personnel with this tremendous responsibility.

During the hot summer week of July 19-24, 2013, HondaJet, with the assistance of RRS personnel and other Wallops services, conducted 16 runs or "cards" through the water pit to collect valuable data to evaluate the characteristics of the HA-420 aircraft in a standing water

environment.

Many services had to come together to create a safe, effective environment to conduct such an operation. An RRS project manager ensured the cooperation and collaboration between HondaJet, optical systems, RF communications, the weather office and the Wallops Fire Department.

After weeks of discussions to outline all requirements, the configuration included:

- The Wallops Fire Department fabricated a 200-foot long trough on runway 04-22 allowing water to pool to the necessary level – approximately one half inch
- A unique Optical Systems configuration using a new

Mobile Optical Tracking System (MOTS). This system provided a video track of the aircraft as it made its way through the water trough. After each run, video data was quickly processed and presented to HondaJet personnel before the next operational run

- On-call photography
- Weather Office operations to keep everyone abreast of current and future conditions
- Mobile communications

The results of these tests will allow HondaJet to evaluate their aircraft and submit the data to the Federal Aviation Administration (FAA) for airworthiness certification.

HondaJet plans a return trip to the Wallops Range in the near future to continue testing.

DoD conducts defense testing

WALLOPS ISLAND, Va. — Mission preparedness is a staple of the Department of Defense (DoD) and the Research Range Services (RRS) program is at the ready to assist the DoD when the need arises. The Missile Defense Agency (MDA) sponsored two such missions during the past year.

Known as MDA Shark+, these unique missions presented a quick turn project utilizing suppliers from outside the NASA establishment. The direct customer for MDA Shark+ was the Naval Surface Warfare Center Port Hueneme Division Detachment out of White Sands Missile Range, N.M., who served as MDA's empowered mission integrator. The sounding rocket provider was the Northrop Grumman Corp. Technical Services Sector with facilities in Princess Anne, Md.

The purpose of the MDA Shark+ missions was to engage an off-board missile defense sensor against the target rocket's payload. The RRS team provided ground instrumentation, communications, surveillance, meteorological and ground operations support for the mission. Only two of a possible four scheduled launches associated with this project have been executed. The remaining launches are currently scheduled for the early part of 2014.

A long-exposure photograph shows the takeoff of the Terrier-Lynx launched for a Department of Defense training exercise.

LAUNCH VEHICLE	Terrier-Lynx with a 3rd stage Star 13C
MISSION:	MDA Shark+
WALLOPS ID:	NRW-5399; NRW-5420
LOCATION:	Pad 2 - ARC, MRL
LAUNCH DATE:	Sept. 21, 2012; March 11, 2013
LAUNCH TIME:	12:45 a.m. EST; 6:09 a.m. EST

Pax River flights soar over Wallops

PATUXENT RIVER, Md. — Patuxent Naval Air Station (Pax River) in southern Maryland is a mainstay customer of the Research Range Services (RRS) program as personnel have been providing support for test and development of Naval Air Warfare Center Aircraft Division (NAWCAD) aircraft since 1996.

Service requirements continued through 2013, with RRS staff supporting the project, known as Pax River, on operations occurring six days per week on average. Requirements are mainly for Navy test flights of the F-35 Joint Strike Fighter. These flights consisted of “bent-pipe” telemetry flows, relaying telemetry from the aircraft back to Pax River. Air traffic management support is also provided for all MH-60 and search and rescue (SAR) helicopter airfield activities. Demonstrating flexibility and stewardship, RRS staff supported additional aircraft, such as F-18 Hornet and P-8, to meet ever-changing customer needs. This year RRS provided support on 248 days, which included many weekend operations.

In a first for Wallops, RRS supported ALE Drop Operations with the F-35 aircraft. The Pax River F-35 Integrated Task Force (ITF) utilized air traffic management, telemetry, frequency monitoring, optical and communications support for this unique mission.

Upon completion of the event, scheduled exclusively on Saturdays, Danny Vereen from Pax River sent a letter to Wallops stating: “Thanks for the wonderful support you provided to the F-35 team this year. Our mission was a success and the support provided by the Wallops team was critical to this success. We look forward to working with you in the future. Your support, coordination, and patience are greatly appreciated.”

The RRS airfield served as primary divert field for the X-47B unmanned aircraft during flights between the Patuxent Naval Air Station and an offshore carrier. In this role, RRS supported the first launch of an unmanned drone from an aircraft carrier catapult at sea by providing radar and telemetry tracking.

Wallops successfully delivered divert field services when called upon in July 2013, providing smooth landing and takeoff assistance to the X-47B aircraft. For departure from Wallops, RRS personnel established a communications link and real-time video stream of vehicle flight to Pax River. Wallops Range radar and telemetry services also provided data crucial for Pax River Range Safety staff to monitor the aircraft during takeoff.

The X-47B aircraft is prepared to take off from the 4/22 runway at RRS Airfield.

Educational outreach marks forefront of Range goals

Benjamin Franklin once said of education: “an investment in knowledge pays the best interest.” In keeping with this philosophy, the Research Range Services (RRS) program has made significant investment in the education of students and interns. 2013 marked the continuation of a long tradition of student-supported sounding rocket launches at Wallops Range.

Annually, RRS supports hundreds of college students and their professors from around the country by assisting in the launch and recovery of sub-orbital vehicles and payloads.

Many RRS services are required to safely and effectively launch a student sounding rocket. For instance, each student launch required scheduling, Range

timing and communications, radio frequency (RF) monitoring, radar, surveillance, data processing and display operations, payload recovery, meteorological operations, optical systems, and project management.

This past year, two such launches took flight from the Wallops Range: RockOn VI and RockSat-X.

RockOn VI

In the early morning hours of June 20, 2013, a Terrier Mk12 - Improved Orion sounding rocket took flight from the Wallops Range at the Pad 1 50K launcher. Approximately 30 students and faculty worked on multiple payloads for this mission. Out of several science experiments on-board the vehicle, one standout was an experiment attempting to determine the intensity of ultra-violet radiation changes with altitude to create an ozone density profile for the atmosphere.

The RockOn workshop is intended to be an introductory flight opportunity providing exposure to university undergraduate students and their instructors in space-based science missions. The long-term goal of the RockOn workshop is to provide a minimally subsidized, self-sustaining, annual training program for the university community.

This year, the following universities participated:

- Embry Riddle Aeronautical University
- Carthage College
- Mitchell Community College
- Temple University
- The Naval Academy
- Miami University
- Eastern Shore Community College
- University of Nebraska

The ‘RockOn’ workshop is a collaborative effort by the Colorado Space Grant Consortium (CSGC), the Virginia Space Grant Consortium (VSGC), and the Wallops Flight Facility.

RockSat-X

In an extension of RockOn, RockSat-X featured a Terrier MK12 - Improved Malemute sounding rocket which pierced the skies above the Wallops Range Aug. 13, 2013, as more than a hundred students looked on from a safe distance.

This mission provided students and professors from seven universities the opportunity to launch eight individual experiments. The schools who participated were:

- West Virginia University
- Johns Hopkins University
- University of Maryland at College Park
- University of Colorado at Boulder
- University of Minnesota
- Northwest Nazarene University
- University of Puerto Rico

This launch not only provided students with the opportunity to develop payloads, but allowed students to obtain experience with attitude control system (ACS) capabilities and technologies.

This mission included a unique challenge for surveillance and recovery operations, as the principal investigator requested the payload be retrieved from the Atlantic Ocean for further analysis. Recovery of the payload was successfully conducted utilizing a single sea vessel roughly 90 miles off shore with the aid of two aircraft.

RRS is honored to continues its role in shaping the minds of tomorrow’s engineers, technicians, scientists and, yes, even astronauts!



RockSat-X took off with eight university experiments onboard.

LAUNCH VEHICLE	Terrier Mk12 - Improved Orion
MISSION:	RockOn! VI
WALLOPS ID:	NRW-5400
LOCATION:	Pad 1 - 50K
LAUNCH DATE:	June 20, 2013
LAUNCH TIME:	5:30 a.m. EST

LAUNCH VEHICLE	Terrier Mk12 - Improved Malemute
MISSION:	RockSat-X
WALLOPS ID:	NRW-5401
LOCATION:	Pad 2 - ARC
LAUNCH DATE:	Aug. 13, 2013
LAUNCH TIME:	6:00 a.m. EST

Every year, RRS hosts a wide variety of local community organizations offering tours, group discussions, and even onsite classroom education. Despite their differences, all participants, from elementary students to senior living residents, retired government employees to boy and girl scout troops, have a common goal; to learn more about NASA. In conjunction and coordination with

the NASA Wallops Visitors Center, RRS personnel are happy to help educate our friends who are interested in everything NASA!

As part of the tours, RRS personnel provide historical information about the Wallops Range dating back to 1945 and explain the latest technologies used in today’s launches. Tour groups are given a simulation of launch operations in

the Range Control Center, taking seats at the consoles, listening to the speaker’s presentation over headsets, and viewing weather and surveillance data displays, just as they appear on launch day. As part of the Virginia Space Flight Academy summer camp program at Wallops, weekly tours are given in the RCC, and are a highlight of the program, featured prominently on the academy website.

- Williamsburg Montessori School
- Moravian Academy, Bethlehem, Pa.
- Weber State University, Ogden, Utah
- Disability Mentoring Month
- Tidewater Community College
- Boy Scout Troop 281, Ocean View, Pa.
- The Parke at Ocean Pines
- Arcadia High School
- Worcester Technical High School
- Broadwater Academy First Grade
- University of Maryland Eastern Shore
- Mallard Landing
- Virginia Community College Board
- Salisbury University STEM
- Institute for Learning in Retirement, Virginia Beach, Va.
- University of Cincinnati
- Middle School Safety Awareness – multiple schools attended

- Worcester County Prep
- Wallops Rocketry Academy for Teachers and Students
- Delaware State University
- Virginia Space Flight Academy
- Civil Air Patrol
- Horizon Program, Salisbury, Md.
- Virginia Space Flight Academy
- Road Scholar Family Camp, Marine Science Consortium
- Road Scholar Discover, Marine Science Consortium
- Virginia Space Flight Academy
- Worcester County Camp
- NASA Rocket Propulsion Test Program
- Virginia Space Flight Academy
- RockSat-X Students & Faculty
- Nanticoke Senior Center
- Girl Scouts from Lansdale, Pa.
- Commonwealth Academy, Alexandria, Va.

Field Carrier practice begins

Airfield enables critical Navy flight training



An E-2 Hawkeye practices landing on the simulated carrier deck painted on the Wallops Range runway.

WALLOPS RANGE, Va. – A new style of mission is hitting the Research Range Services (RRS) airfield in the next fiscal year as the Field Carrier Landing Practice (FCLP) mission makes its way to the Wallops Range. This mission is intended to provide training to Navy personnel, as it relates to safely landing an aircraft aboard an aircraft carrier. Navy pilots will be flying E-2 Hawkeye and C-2 Greyhound aircraft, totaling approximately 10,000 touchdowns per year as well as 20,000 flight passes.

The Navy has agreed to conduct such operations at the RRS airfield; subsequently, RRS has taken on the responsibility of providing support and services to achieve the Navy’s objective. At the time of publication,

RRS has painted a mockup of an aircraft carrier’s landing deck on runway 04-22 and will provide other Range upgrades.

The RRS program has established several objectives to achieve these success criteria. The first objective will include the development of simulated carrier deck runways and their maintenance, development and installation of the necessary power, communications and tie-down/parking interfaces for mission-specific systems. These include the Improved Fresnel Lends Optical Landing System (IFLOLS), Manually Operated Visual Landing Aid (MOVLAS), and the Landing Signals Officer (LSO) Shack ground support equipment. Second, RRS will provide air traffic control class D

services and airspace management to include after-hours support as needed, access to R-6604 airspace, fueling services, and ground mobile radio communications. Finally, RRS personnel will coordinate services to include scheduling, range support, logistics, and ground support equipment maintenance support.

The RRS program has successfully completed the installation and checkout of the simulated carrier deck runways as well as the concrete pad staging locations complete with power and communications interface modules. The IFLOLS, MOVLAS, and LSO Shack ground support equipment have passed functional check out using these interface modules.

NASA Low Density Supersonic Decelerators

PACIFIC MISSILE RANGE FACILITY, Hawaii – The NASA Curiosity rover is a car-sized robotic rover weighing approximately 2,000 pounds and is currently exploring the surface of Mars. This incredible human achievement also underlines a limitation of the decelerator technology used to used to successfully land the Curiosity rover on the alien planet. The purpose of the NASA Low Density Supersonic Decelerators (LDSD) project is to develop a 30.5 meter Supersonic Ringsail (SSRS) parachute and

a 6-meter diameter Supersonic Inflatable Aerodynamic Decelerator (SIAD). These new supersonic decelerator technologies will allow NASA to deploy larger mass objects with greater accuracy on future Mars missions. These technologies are necessary to realize any future human mission to Mars.

NASA Wallops Flight Facility (WFF) is providing the scientific balloon through the NASA Columbia Scientific Balloon Facility (CSBF), the test vehicle’s electronic system through the Applied Engineering

Technology Directorate (AETD) at WFF, and Range safety support via the WFF Safety Office. Research Range Services (RRS) personnel will provide Range services and project management. The LDSD project is a multi-year project with testing taking place at multiple NASA and Department of Defense facilities. The final Supersonic Flight Dynamics Test (SFDT) portion of mission execution will take place at the U.S. Navy Pacific Missile Range Facility (PMRF) in summer 2014 and 2015.

Missile Defense Agency Raid Launch

WALLOPS RANGE, Va. - The U.S. Navy Aegis Ballistic Missile Defense (BMD) Program is the Sea-Based Missile Defense (SMD) element of the Missile Defense Agency (MDA) and will conduct exercises at the Wallops Range in 2014. The purpose of this project is to conduct a simulated engagement of a raid of short-range ballistic missile (SRBM) targets with two Aegis BMD ships using digital engagement coordination.

Research Range Services (RRS) personnel will assist the MDA for this mission during the launch of two salvos of three sounding rocket launches. The first salvo will be launched from the shores

of the Wallops Range in January 2014 during the Field Tracking Exercise 18 (FTX-18) and involve three U.S. Navy Aegis Readiness Assessment Vehicle Type-A (ARAV-A) Terrier-Improved Orion vehicles. The second salvo will be launched in January 2015 during the FTX-19 event with three ARAV Type-B (ARAV-B) Terrier-Oriole sounding rockets.

RRS personnel will provide telemetry services from vehicle turn on to horizon loss of sight for each of the three rockets. Fixed and mobile assets will be utilized for tracking, receiving, relaying, recording and readout capabilities. Also, four radars sites will be prime with one spare unit

on standby. Optical systems support will capture high-speed video data to capture motor ignition, umbilical release and vehicle egress from the rail. Visible optical tracking will provide data through flight until loss of sight. Launch System Integrations services will be provided along with surveillance services.

The beginning of 2014 will be a complex year with regards to supporting a salvo operation requiring a significant amount of RRS services and personnel while simultaneously supporting launch operations at Poker Flat Research Range, near Fairbanks, Alaska.

GREECE mission destined for Poker Flat Research Range

FAIRBANKS, Alaska —This year, once again Research Range Services (RRS) personnel are planning to take on the Arctic winter in order to support a launch campaign from the Poker Flat Research Range.

This year’s mission, occurring in the Winter of 2014, will be a single Terrier-Black Brant IX sounding

rocket carrying the Ground-to-Rocket Electrodynamics Electrons Correlative Experiment (GREECE) experiment that will study the aurora borealis.

RRS will once again provide support across several service areas including telemetry, radar tracking, meteorological operations, engineering,

communications, data quality, and photography. The team plans to travel in early January to configure the Poker Range and test the systems. RRS will also work with NASA’s Sounding Rocket Program Office personnel and PFRR range personnel to ensure the scientists are able to gather the data they need to learn more about our atmosphere.

Engineers modernize Range assets

WALLOPS RANGE, Va. – The Wallops Range is constantly striving to modernize its Range ground systems in order to meet more stringent customer demands and to replace an aging infrastructure. The Range has taken a systematic approach to identify systems in need of modification or replacement and address those systems in an efficient manner.

The primary tool for identifying systems in need is the Range Obsolescence Chart. Systems are identified as “Green”, “Yellow” or “Red”, depending on risks tied to the current capability to meet Range customer or Range safety requirements. Of course “Red” and “Yellow” systems receive the

most engineering attention and are the prime candidates to become sustainment or upgrade projects.

The primary drivers that cause systems to go red and initiate engineering projects are twofold: new customer requirements and unsustainable systems. For example, the arrival of Antares/ Cygnus kicked off a myriad of new engineering efforts in order to support the much greater demands of that all-new launch vehicle and spacecraft; the upcoming multi-launch missions at Poker Flat Research Range, near Fairbanks, Alaska, drove enormous increases in our capability to support both command and telemetry from that remote site; high failure rates

and lack of available replacement parts kicked off a major project to modernize the Wallops flight safety command systems.

In all cases, Research Range Services personnel have been able to meet its customer requirements without delay to the mission set. Furthermore, the Range continues to modernize its resources across the spectrum of instrumentation systems and facilities, incorporating innovative engineering and the latest proven technologies to increase reliability and capability.

Below is a series of information outlining engineering projects during the past fiscal year.

Redstone No. 2 Antenna Installation

Fiscal year 2013 has seen some major changes in the Range infrastructure of the Poker Flat Research Range near Fairbanks, Alaska. The complexity of the planned Poker campaign in 2014 made installation of a second Redstone antenna a necessity since the active launch schedule back at the Wallops Range meant several deployed assets were tied up and not available.

Research Range Services (RRS) personnel began interfacing with the University of Alaska, and with the pad

being completed in early July 2013, the team began assembly of the antenna.

Once on site, the RRS team worked with personnel from the University of Alaska to re-design the Servo Amplifier Building (SAB) layout and ensure the electrical upgrades required in the SAB were compatible with the mechanical layout of the room. By the end of August 2013, the antenna was installed, powered, tested and ready to support upcoming sounding rocket campaigns from Poker Flat.



RRS personnel work on putting the final touches on the Redstone antenna at PFRR.

Range Telemetry Processor Sustainment

Early in the planning phase for Antares support, RRS engineers and technicians identified a legacy telemetry data processing deficiency which would have prevented the Range from providing critical safety and tracking support for the mission. Completing the last steps toward operational support, the RRS team completed safety-critical

reliability testing of the system and conducted an Operational Readiness Review to gain Range Safety certification for the first generation of Vehicle Telemetry and Range Safety (VTARS) units. The system was implemented in mobile telemetry and supported various sounding rocket missions as well as the Antares and LADEE missions.

The next phase of this project is to get the second generation of VTARS units and a newer operating system for all units safety-certified. RRS engineers have written the test plan and the fault-mode test procedure and drafted the reliability test procedure. Final system testing and certification is set to be completed in fiscal year 2014.

Wallops Video Project Phase 2, Launcher Shelter Surveillance

A necessary upgrade for safety and security during sounding rocket operations was the installation of a Launcher Surveillance System for each of the sounding rocket launcher facilities. Before the project, RRS personnel had no video surveillance within the shelters, creating a void in safety’s situational awareness during pre-launch operations.

RRS provided project management

and technical support to develop and install a camera surveillance system that is capable of recording high-definition video from multiple cameras and distributing the data to the Range Control Center.

These surveillance cameras now provide critical video surveillance to Range Safety personnel, RRS test directors, and launch pad supervisors.



Nine surveillance cameras were added to the sounding rocket launcher shelters.

GHOC-E Activation

The RRS support role in Global Hawk Operations Center-E changed a couple of times during the past year. Initially, RRS support was requested for the KU SatCom System and the Remote Antenna Group (RAG). RRS support was then re-scoped and requested for project management, systems engineering and integration support for the Flight Operations Room (FOR), the Payload Operations Room

(POR), the System Equipment Room (SER), the radio control room, the Local Antenna Group (LAG) and RAG. This systems engineering support request was then re-scoped to RF technical support for the RAG, LAG, radio control room and installation of the operator workstations.

The RRS team supported the installation, integration, and test of the LAG and RAG. The LAG

is 16 communication antennas comprised of 12 Iridium, 3 UHF, and 1 GPS. The RAG has 2 UHF antennas.

The RRS team completed its GHOC-E build-up support services, responding to a last minute request to install, make power and data connections, and functionally checkout the 20 workstation computers.

Mobile Optical Tracking Station

The Mobile Optical Tracking System (MOTS) is a newly developed optical tracking station designed, developed and built by RRS engineers and technicians.

This system is comprised of two trailers – one for system command and one for acquisition. An optical technician will be stationed in the command trailer for all operations to control the system. The acquisition trailer can be in any location which benefits the operation, including within the hazardous area while operators are safely outside the zone. Multiple high definition cameras are configured in parallel on an optical mount on the acquisition trailer for video collection. The data generated is transferred to digital recording systems within the MOTS system and further distributed to the Range Control Center in real-time. This data is recorded at an extremely



The MOTS is a newly developed optical tracking station that allows a tracker to be located within the hazardous area, while the operator is safely in a command trailer elsewhere.

high quality format – 1080p, 59.94 frame rate, up to 100 mbps – which will allow for forensic analyses if necessary.

The system is also capable of “auto tracking” services. RRS engineers designed the system to ingest ethernet launch trajectory acquisition system (ELTAS) data from any of the Wallops radar sites so the MOTS can automatically track targets, such

as aircraft or launch vehicles. In this mode the optical technician can monitor the system to ensure the track is good, but if for some reason there is a failure within ELTAS data stream, the technician can revert to manual tracking.

MOTS will allow RRS to collect never-before-seen optical tracking data for most Wallops Range Operations.

Command TDM Upgrade

As the Wallops safety-critical command system has aged, RRS personnel were quick to identify a need to upgrade the current method of transmitting command tones and receiving transmission verifications due to equipment obsolescence issues and the limited availability of spares.

The limiting equipment was identified as the Time Domain Multiplexers (TDM), which are responsible for transmitting and receiving multiple signals across

a common path. The limitation on sparing is due to a combination of obsolete, unsupported systems and the fact that two mobile command systems that utilize the same pool of components are deployed to both Coquina, N.C., and Bermuda in support of ELV launches.

The project team was assembled by RRS personnel and included members of Range Safety, AETD and Range engineering/operations. RRS personnel are not only responsible for managing the

project but also completing the design, procurement, installation, testing and safety certification of the new system. Due to the active range schedule the project is estimated to span approximately eight months. Thus far the team has developed approved requirements and conducted a design review and initiated procurements. During the next several months the RRS team will build, bench test, implement and perform safety testing on the new system.

Electric Field Mill Installation

Electric Field Mill information is used for lightning forecasts and to increase Range and mission safety. The system also integrates the National Lightning Data Network (NLDN) information to provide real time lightning information for forecasters, Range users and safety personnel.

Obsolescence issues required RRS engineers to replace and upgrade the existing Electric Field Mill system, which is approximately 20 years old. The upgrade included new modems and sensors at seven diverse locations, providing two new front end computer systems, and redesigning the network and power architecture to maximize sensor efficiency. Three of the sensors in low-lying areas on the Wallops Range were placed on five-foot concrete blocks to prevent erosion caused by periodic flooding. The EFM system upgrade was completed in 2013 with first successful support of the ATREX mission.



Three of the sensors in low-lying areas on the Wallops Range were placed on five-foot concrete blocks to prevent erosion caused by periodic flooding.

SureTrak System Testing

Testing of the new SureTrak surveillance system has been in full swing during 2013, with the team working to develop and execute test procedures as well as documenting the results. The engineering team made steady progress, successfully testing all “mitigate through demonstration” and airborne radar requirements, as well as working through several fixes for discrepancies found while testing. The team

has also completed all of the sea surveillance requirements and is working with NASA Safety on the “Probability of Impact Module” requirements.

Early in the year, the team was informed that Patuxent River Naval Air Station would be upgrading their operating system and the version of SureTrak currently in use at the Wallops Range would no longer be compatible with their systems.

The Range decided to upgrade to the new system to stay consistent with the capabilities provided by Pax River. Although this upgrade has not yet occurred, the team has been diligently preparing for it, in the hopes of completing current system module testing prior to the upgrade. This will allow the team to perform regression testing on the new system relatively quickly and then press forward to system-level testing.

IT Security

The Wallops Range Instrumentation Systems (WRIS) IT Security Project secured, documented, audited and continuously monitored Wallops Range instrumentation systems by applying federally mandated security controls to achieve and maintain the Authorization to Operate (ATO) status of the Range. The IT Security team continues to develop plans and documents to meet ATO milestones and keep WFF on track to full compliance.

To keep the Range operating and obtain ATO, RRS personnel consolidated five separate Range-specific security plans into a single security plan, encompassing all WRIS. RRS also developed and implemented information security local operating procedures to specifically meet NASA IT security mandates that will mitigate and compensate unmet security controls across WRIS. Furthermore, RRS developed

and implemented data capture procedures and engineering templates to capture any system addition, replacement, retirement and modification, in order to maintain a current and accurate WRIS System Security Plan/Contingency Plan and database.

RRS completed the actions for the required 90-day ATO response and is currently developing the one-year conditional ATO responses to the GSFC Authorizing Official/Deputy Center Director. The 90-day requirement was to develop a written plan to comprehensively address issues related to Flaw Remediation, Vulnerability Scanning, Security Control mitigation and a Gap Analysis to address the “as-is” condition as compared to the NASA IT Security Handbook requirements.

The one-year requirement is to develop a detailed written

analysis of the WRIS wide infrastructure modernization/upgrade. Towards this goal ROC has assessed, researched and compiled innovative solutions to document a written Wallops Range modernization plan to meet future NASA IT Security requirements without impacting the mission and with respect to future Range growth.

RRS is managing-to-closure approximately 20 post-ATO assessment Plans of Action and Milestones (POA&Ms), which are to be fully documented in the NASA Risk Management System.

In an on-going effort, RRS continues to actively develop and adjust IT security and configuration management procedures and processes in order to take a proactive role in meeting NASA IT security requirements across all Range Instrumentation.

RFDF and EMCON

The Radio Frequency Direction Finder (RFDF) and Emissions Control (EMCON) Systems provide RF spectrum monitoring and surveillance. Each system was engineered to encompass frequency ranges from 20 MHz to 3 GHz and 20 MHz to 18 GHz, respectively.

In addition to tracing RF emissions by frequency, power and field

strength, the RFDF system also provides geo-location coordinate mapping to indicate the direction and location of the RF source under surveillance.

Research Range Services continued improvements during development of the system, including bringing all three RFDF sites online. The final site – at Assateague Island – was added

to the system following alignment of the antennas providing the microwave communication link between the remote site and Wallops Main Base. The systems continue to be used on an engineering test basis, providing valuable data to missions and helping to identify and eliminate interfering signals.

Lightning Detection System

To meet current Federal Aviation Administration (FAA) regulations for commercial launches and other mission-related restrictions, the Lightning Detection and Ranging (LDAR) system – nearly 30 years old – underwent enhancement in 2013. LDAR was augmented with an additional system to provide reliable lightning detection data at all levels of the atmosphere, including in-cloud, cloud-to-cloud and cloud-to-ground strikes. With this enhancement, the Range now boasts state-of-the-art lightning

detection at Wallops.

RRS supported this effort on two fronts. A new regional network comprised of 10 sensors was incorporated into the existing Leading and Environmental Display System (LEADS) processing and display system. The two systems working in conjunction constituted a significant increase in capability compared to the previous LEADS configuration, comprised of only four local sensors.

RRS engineering also implemented

a new solution system to augment the old LDAR system. The new system, known as Total Lightning Solution (TLS), functions in parallel with the legacy LDAR system. TLS integrates the Earth Networks Total Lightning Network (ENTLN) data to LEADS to provide real-time lightning display, data interrogation for the lighting metadata, and archiving. The capability also uses RTStreamer, a web-based lightning reporting tool which is able to function as a back-up system to the local lightning display on LEADS.

Weather Office

The Research Range Services Weather Office was renovated in 2013, adding space and improved displays for critical mission operations briefings on weather information and forecasts. The project required the systems and equipment be completely removed from the existing office while the upgrades could take place, which drove a particularly challenging schedule in a busy launch year to ensure that no operations were impacted by the relocation. RRS developed a innovative plan and efficiently carried it out by performing the relocation activities over weekends thus limiting impact to operations.



The upgraded weather office allows more room and better displays to brief critical weather information to the range during mission operations

Weather Radar Upgrades

In 2013, the Range completed upgrades to weather stations for Radars 2, 3, 5, 8, 10 and 11. All obsolete weather system equipment was disconnected and removed from each radar. The new systems have been installed and are in operation now, providing detailed environmental data. With this upgrade, each radar now has access to calibrated, real-time weather information, crucial for performing refraction corrected precision tracking requirements.

As well as supplying calibration data, the units assist in operational decisions based on outside temperature and wind speed. It is imperative to operate the radar system within the environmental boundaries set by the manufacturer, to prevent damage to the antenna.

Additional benefits of the new systems include; an increase in reliability due to the lack of moving parts, added lightning protection and the availability to interface with the unit via a computer terminal

to check system health and aid in troubleshooting efforts. Since the wind weighting and radar departments use the same weather stations, the availability of system spares has also increased.

For the mobile radar systems, the new units offer a significant decrease in physical size over the legacy systems. As a result, it is now much easier to transport and set up. This advantage translates to significant savings of transport and set-up costs.

ULTRA

The Universal Translate, Record and Analyze (ULTRA) is a computer-based system used to convert data from one format to another in real time as required by a mission, typically generating slaving data to

drive tracking systems on Range instrumentation in support of remote sounding rocket operations. At the close of 2013, the prototype system has been designed, built, and field tested to support operations on

an engineering test basis. Formal system test plans have been developed and the system is set to complete the engineering process and attain full operational status in fiscal year 2014.

Data Quality System

During last year’s Poker maintenance trip, the RRS team began an effort to install a command destruct system in the on-site telemetry annex (TMA) building. A major element of this project was the development of a permanent Data Quality (DQ) operator (RADAC) station at TMA. In the past, the DQ operator has been seated at the edge of a table down in the blockhouse, with only two screens with which to display all of the available data, while a

new system would provide greater capability and move them into the same building as the rest of the range instrumentation equipment.

In the weeks leading up to the PFRR 2013 campaign, operations and engineering personnel worked diligently to construct tables, install monitors and run all required data and timing lines over to the new room. RRS engineers also developed a means to send the RADAC displays back down to the

blockhouse, ensuring the team in that location did not lose any capability due to the move “up the hill.” In the end, the DQ operator went from having two monitors to having six monitors and an entire room capable of supporting up to two DQ operators.

Also during the 2013 trip, command personnel travelled to PFRR to not only perform maintenance on the systems, but also to complete some final system testing which

Technology Development Projects

will be analyzed and used to prove the capability during the system’s Operational Readiness Review. Although the system will

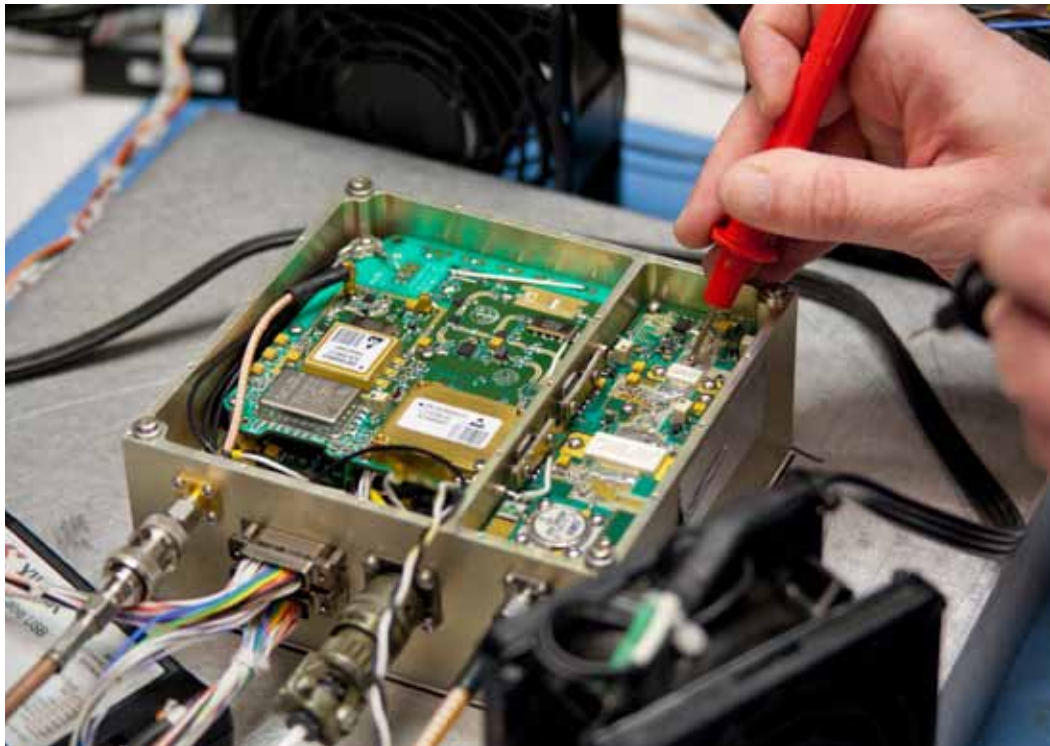
not be certified to support a Safety Command Destruct operation, the end goal is to get the system to a point where it could be

configured and used to support a mission where satellite control is a requirement.

Engineering group delivers state-of-the-art transceivers

During fiscal year 2013, the Research Range Services (RRS) Engineering Technology Development group continued developing and delivering cutting-edge Tracking and Data Relay Satellite System (TDRSS) transceiver technology products. The group successfully delivered two Low-Cost TDRSS Transceiver (LCT2) transmitters to the Lunar Atmosphere Dust Environment Experiment (LADEE) project. The LCT-023 was installed in the LADEE mission with the other unit (LCT-022) serving as a spare. Both units were subjected to standard environmental testing to make them spaceflight-certified, which included prefunctional testing, shock/vibration and thermal vacuum testing, and post-functional testing.

Additionally, the technology development group continued to support the SmallSAT project with development of a new, higher efficiency amplifier design to be used for power-limited missions, such as unmanned aerial systems. During the past fiscal year, RRS engineers successfully tested a final prototype of the high-efficiency power amplifier (HEFPA) to be used as a next generation LCT2 power amplifier (PA).



LCT2 instrumentation

Measured results met the target, with a direct current power usage down to approximately 84 watts at 20 watts power output (40 percent lower usage than legacy LCT2 PAs).

A significant revision in the HEFPA design is the use of thermal vias beneath those devices that have a back paddle as a heat sink. This improves the reliability of the PA, reducing the mean time to failure by a significant factor by reducing the junction temperature of the active devices. Another method

to aid heat flow in this new power amplifier design is the addition of copper metal near the active devices, which helps to conduct heat away.

The engineering technology group also successfully tested a 5-watt PA for long duration balloon applications. The goal of this effort is an extremely low consumption of power, so the entire LCT2 unit may run off less than 40 watts. This unit is currently in prototype development.

Wallops Range Initiatives

The Wallops Range’s five strategic goals outline and establish its path for future growth. To achieve these goals, the Range will pursue specific supporting objectives with associated performance measures and targets that will enable progress to be assessed. To achieve these objectives over the next five to ten years, the Range will pursue a set of initiatives that will drive the performance measures for the objectives it supports.

Range initiatives are grouped into three main categories:

1. Prepare for Change: To make progress toward its strategic goals, the Range must ensure its workforce, partners, and customers understand and agree with the direction it is headed. This group of initiatives focuses on communicating the Range’s strategic goals to achieve buy-in among all affected parties.

2. Establish Baseline and Assess: Initiatives in this group will help the Range make well-considered and transparent decisions regarding future changes. These initiatives are focused on collecting and documenting the Range’s current markets and capabilities and potential future market needs. This information will be assessed to define and pursue the most effective options for future growth.

3. Implement Changes: This group of initiatives consists primarily

of efforts and activities that will enable the Range to make tangible progress toward achieving its strategic goals. It includes efforts to ensure internal organizations are clearly focused on the right priorities, and coordination with external partner and customer organizations to implement changes in order to accommodate future business and growth. In addition, these activities will help the Range in achieving the correct balance across supporting operations, maintaining

and improving facilities, developing its workforce, and building new capabilities.

The first and third initiatives include significant external involvement by ensuring stakeholders are on board with the Range’s strategic goals and direction, and by highlighting specific opportunities for direct involvement in helping to achieve them. To that end, it will be crucial for both internal and external stakeholders to have insight into the Range’s decision-making process in selecting actions for future changes. It is vital that any Range decision process be transparent and collaborative, to include each of its partner and customer organizations. For example, the managers of NASA’s sounding rocket and balloon programs, along with managers of commercial Antares program and Department of Defense orbital transportation and Ballistic Missile Defense activities, need to understand the Range’s perspective on how specific launch and range capabilities will evolve so they can anticipate which capabilities will be available to them in the future. Partner organizations, such as the Virginia Commercial Space Flight Authority, need to be engaged collaboratively and assured that the Range’s decisions are in step with cooperative arrangements and resources to ensure alignment with their goals as well.





During night operations, the Wallops Range falls under the full moon as seen from across Oyster Bay.

An aerial photograph of the Wallops Flight Facility, showing a long runway with the number 22 at its end, various support buildings, parking lots, and surrounding green fields and forests.

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